Relating Software Reliability Engineering Measurement to Maintenance

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Relationship Between SRE and Software Maintenance

- Corrective Maintenance
  - SW shown to be less reliable during test and fielded use undergoes corrective maintenance to remove faults
  - Improving reliability during development reduces corrective maintenance that will be required later

Relationship Between SRE and Software Maintenance (cont'd)

- Adaptive and Perfective maintenance
  - Changes to the software will affect its reliability. Effects of change on reliability may be modeled
  - Improving reliability during development will not necessarily affect the adaptive and perfective maintenance that will be required
  - However, unreliable software will be more difficult to maintain than reliable software:
    - Presence of faults will make characterizing the system's behavior more difficult
    - Misunderstanding will result in errors being made during development, which will be manifested as additional faults in the new and modified software components.

Can SRM Techniques Model Maintenance?

- Corrective Maintenance
  - Methods of Estimating Fault Content/Fault Proneness
    - Measured structural change used as fault surrogate
    - BDF/RCVD
    - Classification Trees
    - ...
- Fault-prone areas will require additional corrective maintenance
- Additional maintenance cost can be estimated using historical fault-repair effort data.

Can SRM Techniques Model Maintenance (cont'd)?

- Adaptive and perfective maintenance
  - Areas that will require more adaptive and perfective maintenance are not readily identified by SRM techniques.
  - Differential effort required to perform modification may be estimated based on required reliablity:
    - Compare required reliability of modified/new components with reliability of existing system
    - Result can be used in cost models (e.g., COCOMO 2000) to estimate differential effort.

How Does Software Maintainability Affect its Reliability?

- One characteristic of maintainable software is that it is understandable
- Reduces errors in understanding software's functionality and interaction with other components
- Likelihood of inserting faults will be reduced
- Reliability of implemented system will be increased.
- Some measurable characteristics of understandable software have also been shown to be related to its fault content
  - low coupling
  - high cohesion
  - longer variable names

Does Reliable Software Have to be Maintainable?

- Realistically, yes
  - Faults must be repaired in a reasonable amount of time (don't annoy the customer by leaving faults in too long!)
  - Adaptation to new environment/addition of new features:
    - Shortest time possible to maintain competitive edge
    - Overall reliability of the system maintained - no new faults!

Does Reliable Software Have to be Maintainable(cont'd)?

- Not necessarily - examples include spacecraft control software and the nuclear codes. Consequences may include:
  - Reduced functionality - addition of new functionality not considered worth the effort
  - More frequent adaptation to new environments - SW works well only under narrow range of conditions
  - Inability to release personnel to other development efforts. Matters in a commercial environment
  - Eventual inability to use software for its intended purpose - effectively reduces reliability